

REMARKS

Upon entry of the present Amendment-C, the claims in the application are claims 1-12, of which claims 1, 5 and 8 are each independent. Claims 1 has been amended by the present amendment. New claims 10-12 have been added.

The above-identified Office Action has been reviewed, the objections and rejections carefully considered, and the Examiner's comments carefully weighed. In view thereof, the present Amendment-C is submitted.

It is contended that by the present amendment, all bases of objections and rejections set forth in the Office Action have been traversed and overcome. Accordingly, reconsideration and withdrawal of the objections and rejections is respectfully requested.

Amendments Presented

In the claims: claim 1 has been amended by specifying that a method of manufacturing a hollow cylindrical body includes the step of, while the protrusions are gripped, friction-stir-welding abutting regions of the end faces of the plate material to join the end faces to each other.

New claims 10-12 have been added by the present amendment. Claims 10, 11 and 12 depend from claims 1, 5 and 8, respectively, and define additional aspects of the respective claims.

Applicant respectfully submits that the above amendments to the claims, including new claims, are fully supported by the original disclosure including drawings. Applicant also respectfully submits that no new matter is introduced into the application by amending the claims and/or by adding new claims, since the entire subject matter thereof was expressly or inherently disclosed in the original claims, specification and the drawings.

Claim Rejections – 35 USC §102

In the Office Action (page 2, item 4), the Examiner rejected claims 5-7 under 35 USC §102(b) as being anticipated by Colligan et al. (US 5,794,835) (hereinafter “Colligan”). According to the Examiner’s interpretation, Colligan teaches all required features of the claimed friction stir welding process as recited in these claims.

Applicant’s response:

Upon careful consideration, applicant respectfully traverses such rejection, and submits that the rejection is overcome, and that each of claims 5-7 is patentably distinct over the disclosure of Colligan for the reasons discussed below.

Specifically, applicant respectfully submits that Colligan fails to disclose a workpiece plunging member being displaced from a boundary line between a first end face and a second end face to a second end within a range less than or equal to the radius of the workpiece plunging member, as required by independent claim 5.

For example, applicant notes that Colligan discloses a method of friction stir welding. More specifically, Colligan discloses a cutting tool improvement for machining a friction stir weld, which is not related to the claimed invention.

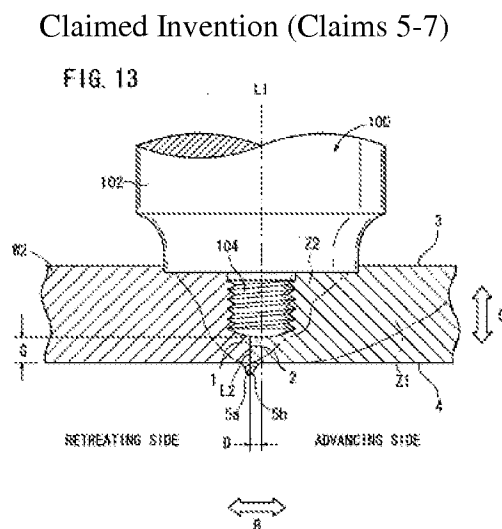
According to the method of friction stir welding, as disclosed in the Colligan reference, a pair of workpieces (e.g., aluminum alloy plates) 1A, 1B are butted together along a joint line 2. A non-consumable probe 3 (e.g., a steel probe) having a narrow, central, cylindrical tip portion 4 positioned between upper and lower members 5, 6 is brought to the beginning of one end of the joint line 2 (col. 3, line 66 – col. 4, lines 10, Figs 1, 4).

The upper (rotating) member 5 having the non-consumable probe 3, is rotated by a motor 7 along the joint line 2. The rotating probe 3 produces frictional heat, and a local region of highly

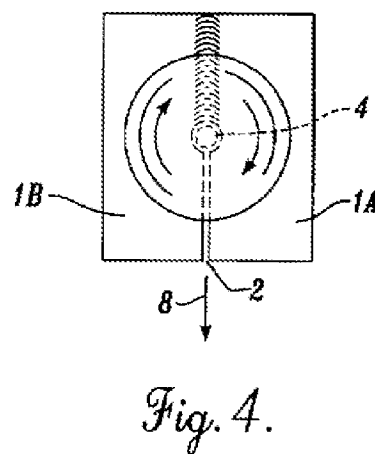
plasticized material around the steel tip portion 4 is formed. Upon removal or through passage of the probe 3, this plasticized stirred region immediately coalesces and solidifies. On cooling, the plasticized material bonds the workpieces 1A, 1B together along the joint line 2 (col. 4, line 11-22, Figs. 1, 3 and 4).

Hence, Colligan fails to disclose plunging a workpiece plunging member with a central region of being displaced from a boundary line between said first end face and said second end face to said second end within a range equal to or smaller than the radius of the workpiece plunging member, as required by claim 5.

Rather, Colligan discloses plunging steel tip portion 4 (workpiece plunging member), along a joint line (boundary line) between end faces (first end face and second end face) of the workpieces 1A, 1B. Thus, the claimed friction stir welding process is patentably distinct from the disclosure of Colligan. Such distinction of the claimed invention from the Colligan reference is further illustrated in the following illustration, which includes representative drawings from the claimed invention and the Colligan reference (Fig. 4).



Colligan Reference (US 5,794,835)



As it can be seen from the illustration, contrary to the claimed invention, Colligan's steel

tip portion 4 (workpiece plunging member), is plunged along with a joint line (boundary line) between end faces (first end face and second end face) of the workpieces 1A, 1B.

Whereas, according to the claimed invention, as recited in independent claim 5, a workpiece plunging member having a substantially circular cross section, which is disposed on a tip end of said friction stir welding tool, is plunged with a central region thereof being displaced (by a distance shown by “D”) from a boundary line between the first end face and the second end face to the second end. The distance D is within a range equal to or less than the radius of the workpiece plunging member.

Accordingly, applicant respectfully disagrees with the Examiner’s allegation, citing his col. 3, lines 48-59, Figure 5C, that Colligan discloses the claimed friction stir welding process. Rather, as shown in the above illustration, Colligan simply discloses a conventional friction stir welding method.

Therefore, applicant respectfully submits that the Examiner fails to establish prima facie case of anticipation for rejection of claim 5. Also, the Examiner fails to establish prima facie case of anticipation for rejection of claims 6 and 7 for the reasons provided in relation to claim 5, and for additional reasons including those discussed below.

For example, as discussed above, Colligan’s steel tip portion 4 is plunged along the boundary line between end faces of the workpieces 1A, 1B. Therefore, Colligan fails to disclose said workpiece plunging member is displaced from said boundary line to said second end by a distance equal to or smaller than one-half of the radius of the workpiece plunging member, as recited in claim 6.

For all of the foregoing reasons, applicant respectfully requests reconsideration and withdrawal of the rejection of claims 5-7 under 35 USC §102(b).

Claim Rejections – 35 USC §103

1. In the Office Action (page 4, item 6), the Examiner rejected claims 1-3 under 35 USC §103(a) as being unpatentable over Colligan in view of Cleveland et al. (US 2002/0020164) (hereinafter “Cleveland”). The Examiner has taken a position that, Colligan teaches the claimed method of manufacturing a body except for that forming a hollow cylindrical body, which in her view, is taught by Cleveland. According to the Examiner’s interpretation, therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to include a tubular product of Cleveland in the process of Colligan, because in her view, a wider variety of geometries of final products allow for a wider variety of application for the products.

Applicant’s response:

As stated above, applicant has amended claim 1, herein. Upon careful consideration and in light of the above amendments, applicant respectfully traverses such rejection, and submits that the rejection is overcome, and that each of claims 1-3 is patentably distinct over the disclosures of the applied references, because the applied references, considered either singly or in a reasonable combination thereof, fail to disclose the claimed invention.

Specifically, the applied references fail to disclose the claimed step of gripping said protrusions and friction-stir-welding abutting regions of the end faces of the plate material to join the end faces to each other, for several reasons including those given below.

For example, applicant notes that Colligan discloses that, in order to avoid pre-drilling a hole in the butting sheets, suitable run-on 12 and run-off 14 extensions are utilized; that where practical, the run-on 12 and run-off 14 extensions provide a starting point and a stopping point for the joint along a weld seam, and that the extensions 12, 14 are later trimmed away. The extensions 12, 14 are added to the joint as separate pieces, or they are made integral with one or

both of the plates to be joined (col. 4, lines 48-60; col. 8, lines 19-27; Fig. 3).

On the other hand, Cleveland teaches a method of stir welding, in which edge surfaces 122-1, 122-2 of a workpiece 106 are connected along a longitudinal direction thereof to form seams 124 of a tubular body portion 102. A non-consumable welding probe 140 is inserted into a gap 142 between the edge surface 122-1, 122-2. Probe 140 is coupled to a driver 144 to rotate probe 140 to generate friction heat to form a welded seam between joining edge surfaces 122-1, 122-2 to form the tubular body portion 102 (paragraph [0021], Fig. 5).

Thus, although Colligan discloses providing the run-on 12 and run-off 14 extensions, he fails to disclose gripping the protrusions and friction-stir-welding abutting regions of the end faces of the plate material to join the end faces to each other, as recited in claim 1. Rather, as discussed above, Colligan provides extensions 12, 14 as a starting point and a stopping point during welding. Colligan does not disclose that extensions are gripped during friction stir welding.

Whereas, a person of ordinary skill in the art would realize that, Cleveland merely teaches a conventional stir welding method. Also, Cleveland fails to disclose holding or securing the abutting end faces of the tubular body in a desired position to prevent them from becoming spaced from each other.

Thus, a person of ordinary skill in the art would not consider it obvious to modify Colligan's method of manufacturing a body by including a tubular product of Cleveland to achieve the claimed method of manufacturing hollow cylindrical body, as proposed by the Examiner, since the each of applied references fail to teach the claimed step of gripping the protrusions of plate material during friction-stir-welding abutting regions of the end faces of the plate material, as required by claim 1.

Further, even for the sake of argument, Colligan's method of manufacturing a body is

hypothetically modified by including a tubular product of Cleveland, as proposed by the Examiner, such hypothetical combination would provide a method of manufacturing a hollow cylindrical body, which will not include the step of gripping the protrusions of plate material during friction-stir-welding abutting regions of the end faces of the plate material.

Rather, such hypothetical combination would provide a method of manufacturing a hollow cylindrical body in which extensions, protrusions, are used as a starting point and a stopping point during friction stir welding.

Here, according to the claimed invention, since the protrusions are gripped in place while the friction stir welding process is in progress, the abutting end faces (abutting regions) of the hollow cylindrical body are prevented from becoming spaced from each other, or the hollow cylindrical body is prevented from becoming opened. Therefore, the friction stir welding process is easily and reliably performed.

Based on foregoing, applicant respectfully submits that the Examiner fails to establish prima facie case of obviousness for rejection of claim 1. Also, the Examiner fails to establish prima facie case of obviousness for rejection of claims 2 and 3 for the reasons provided in relation to claim 1.

Moreover, although the claimed method of manufacturing a hollow cylindrical body is patentably distinct from the applied references, to further expressly define the claimed invention over the references of record, applicant has amended claim 1 herein, by specifying that while the protrusions are gripped, friction-stir-welding abutting regions of the end faces of the plate material to join the end faces to each other.

For all of the foregoing reasons, applicant respectfully requests reconsideration and withdrawal of the rejection of claims 1-3 under 35 USC §103(a).

2. In the Office Action (page 5, item 7), the Examiner rejected claim 4 under 35 USC §103(a) as being unpatentable over Colligan in view of Cleveland and further in view of Lawrence (WO 99/33594) (herein after “Lawrence”).

Applicant’s Response:

As stated above, applicant has amended claim 1, herein. Claim 4 depends from claim 1. Upon careful consideration and in light of the above amendments, applicant respectfully traverses such rejection, and submits that the rejection is overcome, and that 4 is patentably distinct over the disclosures of the applied references, for the reasons provided in relation to claim 1, hereinabove, which are not overcome by additional teachings of Lawrence.

For all of the foregoing reasons, applicant respectfully requests reconsideration and withdrawal of the rejection of claim 4 under 35 USC §103(a).

3. In the Office Action (page 5, item 8), the Examiner rejected claims 8 and 9 under 35 USC §103(a) as being unpatentable over Urschel (US 2,148,714) (hereinafter “Urschel”) in view of Colligan. The Examiner has taken a position that, Urschel teaches claimed welding process except for that the process being a stir welding process, which in her view, is taught by Colligan. According to the Examiner’s interpretation, therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to include a friction stir welding of Colligan in the welding process of Urschel, because in her view, a friction stir welding creates a strong good quality weld.

Applicant’s response:

Upon careful consideration, applicant respectfully traverses such rejection, and submits that the rejection is overcome, and that each of claims 8 and 9 is patentably distinct over the

disclosures of the applied references, specifically, because the applied references, considered either singly or in a combination thereof, fail to disclose the claimed step of gripping said protrusions and friction-stir-welding abutting regions of the end faces of the plate material to join the end faces to each other, for several reasons including those given below.

For example, applicant notes that Urschel discloses an elongated load supporting hollow axel formed of sheet metal. The axel includes two semi-cylindrical members (blanks) 2, 4 joined at respective end portions. The blanks 2, 4 include flanges 8, 10, which are turned inwardly with respect to the semi-cylindrical wall portions 5, 7. The turned in flanges 8, 10 form V-shaped recesses therebetween which are welded to form the hollow axel (page 1, col. 2, line 38 – page 2, col. 1, line 6; Figs. 1 and 3).

Further, another embodiment of Urschel's axel, which the Examiner's cites in her rejection of claim 8, includes a single cylindrical member formed of a blank having end portions thereof joined together. The blank includes flanges 45, 45, which are turned inwardly (or outwardly) of the cylindrical wall portion. The inwardly turned flanges form a V-shaped recess, within which welding material is disposed and welded (page 2, col. 1, lines 65 – col. 2, line 8; Figs. 1 and 7).

Whereas, as discussed above, Colligan disclose a conventional stir welding method for joining a pair of workpieces 1A, 1B together along a joint line 2 (col. 3, line 66 – col. 4, lines 10; Figs. 1, 2 and 4).

Accordingly, the blanks 2, 4 of Urschel, which are formed from sheet metal, do not include the first end face and the second end face having burrs projecting in a thickness direction of the metal workpiece, and that sags projecting in a direction transverse to the thickness direction of the metal workpiece. Moreover, Urschel fails suggest providing burrs and sags

formed on his semicylindrical /cylindrical member in any form.

Thus, a person of ordinary skill in the art would not consider it obvious to manufacture Urschel's axel by employing friction stir welding method as taught by Colligan, as proposed by the Examiner, since the each of applied references fail to teach the claimed friction stir welding process for bringing a first end face and a second end face of a metal workpiece having a curved surface into abutment against each other, in which the first end face and the second end face have burrs projecting in a thickness direction of the metal workpiece, and sags projecting in a direction transverse to the thickness direction, as recited in claim 8.

Further, even for the sake of argument, Urschel's axel is hypothetically modified by employing friction stir welding method of Colligan, as proposed by the Examiner, such hypothetical combination would provide an axle having gaps formed at joining portion of the semi-cylindrical/cylindrical members since the semi-cylindrical/cylindrical members of Urschel do not include claimed sags and burrs formed thereon.

Whereas, according to the claimed invention, an outer circumferential wall is longer than an inner circumferential wall since the sags are provided in outer edge portion of the workpiece. Since the circumferential length of the outer circumferential wall surface is compensated for (increased) by providing sags in transverse direction, when the metal workpiece is curved and end faces are joined, a gap formed between the end faces can be significantly reduced.

Further, such reduced gap between the end faces results in an increase in the area of contact therebetween. Therefore, when the abutting regions are friction-stir-welded, a large amount of material is stirred, producing a sufficient amount of frictional heat. Since the friction stir welding process progresses easily, a large number of cavities are prevented from being formed in the joint. The joint thus maintains a desired bonding strength.

Based on foregoing, applicant respectfully submits that the Examiner fails to establish prima facie case of obviousness for rejection of claim 8. Also, the Examiner fails to establish prima facie case of obviousness for rejection of claim 9 for the reasons provided in relation to claim 8.

For all of the foregoing reasons, applicant respectfully requests reconsideration and withdrawal of the rejection of claims 8 and 9 under 35 USC §103(a).

Drawing Issues

Applicant notes for the record that the Examiner has not indicated whether or not the originally-filed drawings have been approved. Applicant respectfully requests formal confirmation from the Examiner that the drawings are approved for publication.

Other Matters

New claims 10-12 is believed to be in condition for allowance for the reasons provided in relation to claims 1, 5 and 8, hereinabove, and for additional merits thereof.

Conclusion

Based on all of the foregoing, applicant respectfully requests reconsideration and withdrawal of the rejections of record, and allowance of the pending claims. Applicant respectfully suggests that as presently amended, all of the pending claims are allowable.

The application is now believed to be in condition for allowance, and a notice to this effect is earnestly solicited.

It is applicant's contention that no possible reading of the references, either individually or in any reasonable combination thereof, can be viewed as teaching applicant's claimed invention.

If the Examiner is not fully convinced of the allowability all of the claims now in the application, applicant respectfully requests that the Examiner telephonically contact applicant's undersigned representative to expeditiously resolve prosecution of the application.

Favorable consideration respectfully requested.

Respectfully submitted,

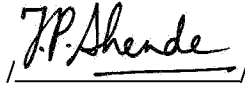


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